

What is claimed is:

1 1. A method for adaptive reduction of ringing artifacts
2 in an input image including pixels of image information,
3 comprising the steps of:

4 (a) selecting a pixel window including a set of
5 pixels from the input image pixels;

6 (b) detecting areas of ringing artifacts in the
7 pixel window based on the pixel information;

8 (c) processing the pixels in the detected areas to
9 reduce the detected ringing artifacts in those areas; and

10 (d) generating an enhanced output image including
11 the processed pixels with reduced ringing artifacts.

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1 2. The method of claim 1, wherein in step (b) detecting
2 the areas of ringing artifacts includes the steps of:

3 detecting areas of ringing artifacts in the pixel
4 window as a function of gradation level differences between
5 one or more pixels therein.

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1 3. The method of claim 1, wherein in step (b) detecting
2 the areas of ringing artifacts includes the steps of:

3 for a pixel in the window, determining the gradation
4 level difference between that pixel and that of neighboring
5 pixels; and

6 detecting if the gradation level difference is
7 within a selected threshold, indicating ringing-like artifacts
8 proximate the pixel position in the window.

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1 4. The method of claim 1, wherein in step (c)
2 processing said pixels includes the steps of performing low
3 pass filtering of the pixels to reduce the ringing artifacts.

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1 5. The method of claim 1, wherein in step (c)
2 processing said pixels includes the steps of performing
3 smoothing on the pixels to reduce the ringing artifacts.

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1 6. The method of claim 1, wherein in step (d)
2 generating an enhanced output image further includes the steps
3 of:

4 generating an enhanced output image comprising: (i)
5 the processed window pixels with reduced ringing artifacts,
6 and (ii) the remaining window pixels.

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1 7. The method of claim 1 wherein the input image
2 comprises a decompressed image.

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1 8. A method for adaptive reduction of ringing artifacts
2 in an input image including pixels of image information,
3 comprising the steps of:

4 (a) selecting a pixel window including a set of
5 pixels from the input image pixels;

6 (b) detecting areas of ringing artifacts in the
7 pixel window based on the pixel information;

8 (c) processing the pixels in the window to generate
9 processed pixels including pixels with reduced ringing
10 artifacts;

11 (d) selecting pixels with reduced ringing artifacts
12 from the processed pixels, based on the detected ringing
13 artifact areas; and

14 (e) generating an enhanced output image comprising:
15 (i) the selected pixels, and (ii) the remaining window pixels.

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1 9. The method of claim 8, wherein in step (b) detecting
2 the areas of ringing artifacts includes the steps of:

3 detecting areas of ringing artifacts in the pixel
4 window as a function of gradation level differences between
5 one or more pixels therein.

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1 10. The method of claim 8, wherein in step (b) detecting
2 the areas of ringing artifacts includes the steps of:

3 for a pixel in the window, determining the gradation
4 level difference between that pixel and that of neighboring
5 pixels; and

6 detecting if the gradation level difference is
7 within a selected threshold, indicating ringing-like artifacts
8 proximate the pixel position in the window.

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1 11. The method of claim 8, wherein in step (c)
2 processing said pixels includes the steps of performing low
3 pass filtering of the pixels to reduce ringing artifacts.

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1 12. The method of claim 8, wherein in step (c)
2 processing said pixels includes the steps of performing
3 smoothing on the pixels to reduce ringing artifacts.

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1 13. The method of claim 8 wherein the input image
2 comprises a decompressed image.

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1 14. A method for adaptive reduction of ringing artifacts
2 in an input image including pixels of image information,
3 comprising the steps of:

4 (a) selecting a pixel window including a set of
 5 pixels from the input image pixels;
 6 (b) detecting areas of ringing artifacts in the
 7 pixel window based on the pixel information;
 8 (c) determining local variance of each pixel in the
 9 window with respect to neighboring pixels;
 10 (d) based on the local variances, detecting if the
 11 location of the window is proximate a noisy area in the input
 12 image;
 13 (e) processing the window pixels to generate
 14 processed pixels including pixels with reduced ringing
 15 artifacts;
 16 (f) selecting pixels with reduced ringing artifacts
 17 from the processed pixels, based on the detected ringing
 18 artifact areas and the detected window location information;
 19 and
 20 (g) generating an enhanced output image comprising:
 21 (i) the selected pixels, and (ii) the remaining window pixels.

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 1 15. The method of claim 14, wherein in step (b)
 2 detecting the areas of ringing artifacts includes the steps
 3 of:

4 detecting areas of ringing artifacts in the pixel
5 window as a function of gradation level differences between
6 one or more pixels therein.

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1 16. The method of claim 14, wherein in step (b)
2 detecting the areas of ringing artifacts includes the steps
3 of:

4 for a pixel in the window, determining the gradation
5 level difference between that pixel and that of neighboring
6 pixels; and

7 detecting if the gradation level difference is
8 within a selected threshold, indicating ringing-like artifacts
9 proximate the pixel position in the window.

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1 17. The method of claim 14, wherein in step (e)
2 processing said pixels includes the steps of performing low
3 pass filtering of the pixels to reduce ringing artifacts.

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1 18. The method of claim 14, wherein in step (e)
2 processing said pixels includes the steps of performing
3 smoothing on the pixels to reduce ringing artifacts.

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1 19. The method of claim 14 wherein the input image
2 comprises a decompressed image.

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1 20. The method of claim 14, wherein in step (f)
2 selecting pixels with reduced ringing artifacts from the
3 processed pixels, further includes the steps of:

4 (f) selecting pixels with reduced ringing artifacts
5 from the processed pixels in the detected ringing artifact
6 areas, based on the window location information.

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1 21. The method of claim 14, wherein in step (f)
2 selecting pixels with reduced ringing artifacts from the
3 processed pixels, further includes the steps of:

4 (f) selecting pixels with reduced ringing artifacts
5 from the processed pixels in the detected ringing artifact
6 areas, substantially in noisy picture locations.

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1 22. A device that adaptively reduces ringing artifacts
2 in an input image including pixels of image information,
3 comprising:

4 a ringing-artifact detector that detects areas of
5 ringing artifacts in a pixel window based on the pixel
6 information, the pixel window including a set of pixels from
7 the input image pixels;

8 an image processor that processes window pixels to
9 generate pixels with reduced ringing artifacts; and

10 a combiner that selects the processed pixels with
11 reduced ringing artifacts in the detected ringing-artifact
12 areas, and generates an output image comprising: (i) the
13 selected processed pixels with reduced ringing artifacts, and
14 (ii) the remaining window pixels.

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1 23. The device of claim 22, wherein the ringing-artifact
2 detector detects the areas of ringing in the pixel window as a
3 function of gradation level differences between one or more
4 pixels therein.

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1 24. The device of claim 22, wherein the ringing-artifact
2 detector determines the gradation level difference between a
3 pixel and that of neighboring pixels, and detects if the
4 gradation level difference is within a selected threshold,
5 indicating ringing-like artifacts proximate that pixel
6 position in the window.

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1 25. The device of claim 22, wherein the image processor
2 includes a low pass filter that reduces ringing artifacts.

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1 26. The device of claim 22, wherein the image processor
2 includes a smoother that reduce ringing artifacts.

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1 27. The device of claim 22, further comprising:
2 a variance detector that determines local variance
3 of each pixel in the window with respect to neighboring
4 pixels;
5 a signal detector that based on the local variances,
6 detects if the location of the window is proximate a noisy
7 area in the input image;
8 such that the combiner further selects pixels with
9 reduced ringing artifacts from the processed pixels, based on
10 the detected ringing artifact areas and the detected window
11 location information, and generates that enhanced output image
12 comprising: (i) the selected pixels, and (ii) the remaining
13 window pixels.

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1 28. The device of claim 27, wherein the combiner pixels
2 with reduced ringing artifacts from the processed pixels in
3 the detected ringing artifact areas, based on the window
4 location information.

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1 29. The device of claim 28, wherein the combiner selects
2 pixels with reduced ringing artifacts from the processed
3 pixels in the detected ringing artifact areas, substantially
4 in noisy picture locations.

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- 1 30. The device of claim 22 wherein the input image
- 2 comprises a decompressed image.